Figure 3.6 - *Illustrative*

Schedule A
02/19/97

KANSAS 1997
KANSAS TEST STUDY
RECURRING COST
TEST INVESTMENT

97-KS-UCS-7821 V2.1
EQUIPMENT INVESTMENT:

1.	EQUIPMENT INVESTMENT (EF&I)			$1000.00
2.	RATIO OF MATERIAL TO TOTAL EF&I			0.85000
3.	SALES TAX	((L1*L2)*	0.050000)	$42.50
4.	TOTAL EF&I INVESTMENT (EF&I)	(L1+L3)		$1042.50
5.	TELCO Engineering	(L4*	0.030000)	$31.28
6.	TELCO Plant Labor	(L4*	0.050000)	$52.13
7.	Sundry & Miscellaneous	(L4*	0.010000)	$10.43
8.	Total Installed Cost	(L4+L5+L6+L7)		$1136.34
9.	Power Investment	(L8*	0.080000)	$90.91
10.	Total Equipment Investment	(L8+L9)		$1227.25
11.	Total Unit Investment With Fill	(L10/	1.000000)	$1227.25
12.	Building Investment Per Unit	(L11*	0.460000)	$564.54
13.	Total Unit Investment	(L11+L12)		$1791.79
	ANNUAL CAPITAL COSTS			
14.	DEPRECIATION	(L11*	0.110000)	
		+(L12*	0.030000)	$151.93
15.	COST OF MONEY	(L11*	0.050000)	
		+(L12*	0.080000)	$106.53
16.	INCOME TAX	(L11*	0.020000)	
		+(L12*	0.030000)	$41.48
17.	TOTAL ANNUAL CAPITAL COSTS	(L14+L15+L16)		$299.94
	ANNUAL OPERATING EXPENSE			
18.	EQUIPMENT MAINTENANCE	(L11*	0.090000)	$110.45
19.	BUILDING & GROUNDS MAINTENANCE	(L12*	0.010000)	$5.65
20.	ADMINISTRATION EXPENSE	(L13*	0.040000)	$71.67
21.	AD VALOREM TAXES	(L13*	0.020000)	$35.84
22.	COMMISSION ASSESSMENT	(SUM(L17..L21)*	0.010000)	$5.24
23.	TOTAL ANNUAL OPERATING EXPENSES	SUM(L18..L22)		$228.85
24.	TOTAL ANNUAL COST PER UNIT	(L17+L23)		$528.79
25.	TOTAL MONTHLY COST PER UNIT	(L24/12)		$44.07

3.12 Non-Recurring Costs

There are two non-recurring costs in the 8dB loop cost study. The first non-recurring cost is for activities involved in provisioning an unbundled loop (service activation) and disconnecting the loop when service is discontinued. Non-recurring costs are computed for the initial loop on an order and for additional loops after the first. Two work groups are involved in the provisioning process:

- *Circuit Provisioning Center*. This group performs several administrative activities related to provisioning an unbundled loop. The group also performs administrative activities when service is discontinued.

- *Installation & Maintenance (I&M)*. The I&M group performs the actual field work for the unbundled loop. Activities include travel, running cross-connects, performing tests and order completion. Activity times are weighted by the percentage of loops which are expected to require field work.

To compute non-recurring costs the activity times for each work group are multiplied by a directly assigned labor rate which include salaries and wages, benefits, direct supervision and other costs directly attributable to an hour of productive labor.

The second non-recurring cost study is for service order processing and includes the activities and costs of the Local Service Provider Service Center (LSPSC). These activities include negotiating, formatting, reviewing and typing unbundled loop orders at the time of service activation and at service disconnection. Activity times are multiplied by directly assigned labor rates for LSPSC personnel.

3.13 Other Loop Costs

In addition to the 8dB loop, monthly costs are computed for basic rate interface (BRI), DS1 and four-wire loops. The study methodologies are similar to the methodology used in the 8dB loop cost study, although cost data are unique to these types of loops. For details on these cost studies, refer to the documentation titled Unbundled Local Loop Study and Unbundled Four-Wire Local Loop Cost Study.

Cost studies also have been completed for the non-recurring costs of work associated with the Network Interface Device at a customers premises and the additional costs of loss conditioning for an 8db loop. Documentation is provided for each of these studies.

Finally, the Network Component Cross-Connect cost study computes the costs of materials and labor necessary to make a physical connection from Southwestern Bell's main distributing frame or other equipment in a central office to equipment owned by an interconnecting carrier. There are several types of cross-connects included in the study.

End Office Switching Costs

4.1 Study Purpose

There are two primary studies for end office switching network element costs.[6] *The end office usage* cost study determines the cost to Southwestern Bell to provide a *minute of use* of local or toll calling on a local switching system based on forward-looking digital switching technologies. *The end office analog line-side port* cost study computes the monthly cost to terminate a subscriber access line on the same digital switching systems.

End office usage costs are calculated for *three geographic zones* corresponding with different *exchange rate groups*. The analog line-side port cost is an average for all geographic zones and exchange rate groups. Switching systems in each zone consisted of a mix of the AT&T 5ESS, the Nortel DMS100 and the Ericcson AXE10 switches. Figure 4.1 illustrates the cost figures calculated in these two end office switching cost studies.

Figure 4.1

	Geographic Zone		
	1	2	3
Cost / Minute of Use	$0.XXXX	$0.XXXX	$0.XXXX
Monthly Cost / Analog Line-Side Port	$X.XX		

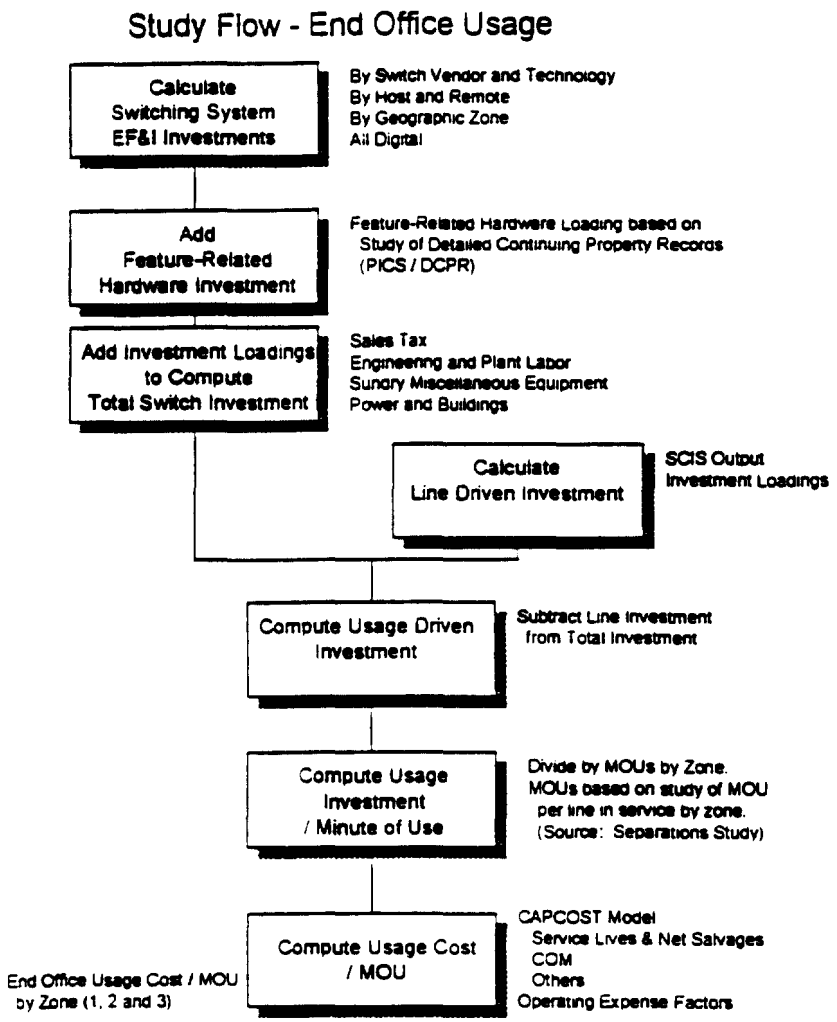
The cost / minute of use and monthly cost / analog line-side port include capital costs on the switching system investment necessary to provide each network element, as well as recurring operating expenses. Plant investment included in the study is assumed to be all digital switching. Buildings investment necessary to house digital switching systems also is included.

[6] See Appendix A for a list of end office switching network elements for which costs have been computed.

4.2 Study Flow

The study flow for calculating end office usage costs is shown in Figure 4.2.

Figure 4.2



- *Switching system EF&I investments.* The first step in the study is to compute the plant investment which would be required assuming *existing digital switches* and *analog switches which are expected to be converted to digital technology in the near future* are replaced using forward-looking digital switching technologies. For example, the investment in an AT&T 5ESS digital switch placed, say, in 1991 would be recomputed as though it was being placed in service today, sized to serve existing demand and using the latest 5ESS equipment and construction costs.

Bellcore's Switching Cost Information System (SCIS) is used to compute these digital switching investments. SCIS is a well-established switching cost model used by local exchange and interexchange carriers in the U.S. and overseas. It provides valid estimates of the total investment and investments per unit of capacity of digital switching systems from each of the major switch manufacturers.

Total switch investments are computed for digital offices for each zone and switch technology.

- *Feature-related hardware and investment loadings.* Switch investments from SCIS include the costs of vendor material and engineering, furnishing and installing (EF&I) the switch at the telco central office. The investment does not include the costs of basic feature-related hardware and other construction costs, such as sales taxes, telco engineering and plant labor, miscellaneous equipment, power equipment and buildings. These costs are added subsequent to SCIS by the cost analyst or during the ACES run. (See Section 3.11 for a description of ACES.)

- *Line driven investment.* Although a switching system consists of numerous functional components, for purposes of computing network element costs the switch is divided between two categories of plant - *line driven plant* and *usage driven plant.* Line driven plant includes equipment necessary to terminate access lines. The amount of line equipment is determined by the number of lines equipped on the switch, rather than usage or the amount of calling over the lines. SCIS separately identifies line driven investment.[7] Usage driven investment for all digital switches in a geographic zone then is computed by subtracting the line investment from the total switch investment.

- *Usage investment / minute of use.* The remaining usage driven investment is for plant used to handle customer calls, provide basic features and handle various switch administrative functions. The predominant driver of switch investment is the number of minutes of use for local and toll calling originating and terminating on the switch. The usage investment in a geographic zone is divided by the annual dial equipment minutes of use for digital switches in the zone. The dial equipment minutes of use are based on minutes of use per line for switches in each zone multiplied times the number of lines in service. Minutes of use per line are determined from Separations data.

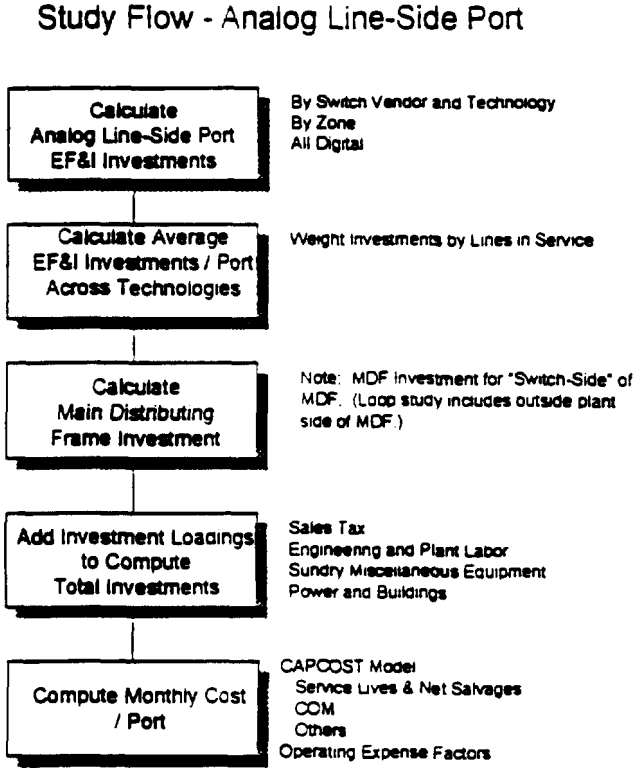
- *Usage cost / minute of use.* The final step in the study is to calculate the cost per minute of use in the three geographic zones. This is done in ACES by applying digital switching capital cost and operating expense factors to the usage investments / minute of use. Capital costs and operating expenses also are calculated for the building plant which houses the switches.

[7] SCIS output reports designate the amount of investment in each switching system which is line driven. The figure used in the cost study is called "Total Minimum Line Investment" from the total investment output report.

The cost study flow for the analog line-side port is similar to the end office usage cost study flow. This is shown in Figure 4.3. The study begins with the line driven investments from SCIS expressed as EF&I investments / line, rather than in terms of total line investment for a geographic zone. Since switch architectures are different among the switch manufacturers, the investments per line differ among the types of switches. For this reason, the study calculates a separate line investment for the 5ESS, DMS100, and AXE10 and then computes a weighted average based on the number of lines of each type.

A small amount of additional investment per line is added for the "switch-side" of the main distributing frame (MDF). Next, the switch line and MDF investments are entered in ACES, and additional investment amounts are added, as appropriate, for sales taxes, telco engineering and labor, miscellaneous equipment, power equipment and buildings.[8] ACES also computes the monthly capital costs and operating expenses per line based on factors from CAPCOST and the operating expense factors.

Figure 4.3



[8] See section 9 for a description of investment loadings.

In the next three sections, additional information is provided on the SCIS model, and the calculations of feature-related hardware and minutes of use per line used in the end office usage cost study.

4.3 Switching Cost Information System

Bellcore which licenses SCIS to Southwestern Bell and other telecommunications carriers describes SCIS as,

> "an interactive computer system that determines the basic switching unit resource investments of a particular type switching system. SCIS may be used to analyze the cost of a single office, or of a group of similar offices ..."[9]

SCIS models are developed for systems manufactured by several vendors, including AT&T, Northern Telecom, Ericcson and others. Switch costs are modeled for host switches, remotes and tandems.

In developing SCIS models for individual switch technologies, Bellcore selects actual switching systems representing a range of line and trunk sizes and usage characteristics. The sample switches are engineered according to the vendor's engineering rules, and switch costs are computed based on actual vendor prices. A detailed analysis of switching system equipment is performed to categorize equipment and costs in functional categories. Following this functional categorization of equipment and costs, costs per unit of capacity of each category are developed. These unit costs are representative of the model office. Unit costs then are used by SCIS to compute the costs of switching systems of different sizes and usage characteristics.

The developers of SCIS routinely test the model to assure that it accurately calculates switching system costs. These tests indicate the model produces switching system costs which are within one - two percent of costs developed using the switch manufacturer's switch provisioning models.

In addition, SCIS has been reviewed by the FCC and several state commissions over the years. In 1992 the FCC discussed its findings regarding SCIS in its Order on Open Network Architecture Tariffs of Bell Operating Companies (CC Docket No. 92-91).

> "SCIS is a forward-looking model that calculates investments based on switch replacement costs rather than historical or embedded costs, and the more recent SCIS software provides the most up-to-date design and pricing basis from which to estimate future BSE-specific investments."" (para. 21)

> The Commission also expressed an opinion regarding the validity of SCIS. "Andersen [independent reviewers of the SCIS model] concluded in its report that, although, SCIS permits users fairly wide discretion in selecting variables, the SCIS model itself is fundamentally sound. This finding is consistent with the

[9] "Bellcore Switching Cost Information System," Section 2 - Introduction, page one.

findings of the Commission's review of the SCIS models submitted to us in camera in December 1991." (para 82.)

4.4 Feature-Related Hardware

Since SCIS calculates only the vendor EF&I costs for a basic switching system, it is necessary to add feature-related hardware and other construction costs to obtain the total investment in a switching system. The feature-related hardware shown in Figure 4.4 is included in the study using a feature hardware factor computed in a special study of financial records.

Figure 4.4

Equipment Item	Quantity	Investment
Conference Ports	XXX	$X,XXX,XXX
Class Modem Resource Cards for Calling Name Delivery	XXX	$X,XXX,XXX
Input / Output Ports for Simplified Message Desk Interface (SMDI)	XXX	$X,XXX,XXX
Power Supply for Message Waiting	XXX	$X,XXX,XXX
Recorded Announcement Equipment	XXX	$X,XXX,XXX
Tone Circuit Equipment	XXX	$X,XXX,XXX
Private Network Trunking Equipment (e.g., Plexar Tie Facilities)	XXX	$X,XXX,XXX
Data Sets or Modems for SMDI	XXX	$X,XXX,XXX
3A Translators for SMDI	XXX	$X,XXX,XXX
Total		$X,XXX,XXX
Total Associated Switching System Investment		$X,XXX,XXX
Feature Hardware Factor		XX%

Quantities and the installed cost of each equipment item are identified for the switching systems in the study from the detailed continuing property records. The total cost of feature hardware then is divided by the total EF&I investment for these switching systems to develop a percentage investment loading for feature-hardware.

The other costs of construction not included in the SCIS investments - sales taxes, telco engineering and labor, etc. - are included in the study using other investment loadings which are described in section 9.

4.5 Dial Equipment Minutes of Use

As described in section 4.2, total dial equipment minutes of use for study switches in each geographic zone are divided into the usage-driven investment for these switches to calculate end office usage investment per minute of use. The dial equipment minutes of use are computed based

on *average minutes of use per line* for each zone times the number of lines in service for study switches. Figure 4.5 shows the calculations used to compute minutes of use per line.

Figure 4.5

Zone	Number of Switches	Minutes of Use			Working Lines	MOU / Line
		Local	Toll	Total		
1	XX	XX,XXX,XXX	XX,XXX,XXX	XXX,XXX,XXX	XXX,XXX	X,XXX
2	XX	XX,XXX,XXX	XX,XXX,XXX	XXX,XXX,XXX	XXX,XXX	X,XXX
3	XX	XX,XXX,XXX	XX,XXX,XXX	XXX,XXX,XXX	XXX,XXX	X,XXX
Total	XX	XXX,XXX,XXX	XXX,XXX,XXX	X,XXX,XXX,XXX	X,XXX,XXX	X,XXX

4.6 Other End Office Switching Costs

In addition to usage and the analog line-side port, which are the primary end office switching network elements, there are other network elements for which costs have been computed at this time. They include the following:

- *Basic Rate Interface Port and Primary Rate Interface Port.* Basic rate interface (BRI) and primary rate interface (PRI) ports provide access to end offices for the use of Integrated Services Digital Network (ISDN) features and functions. The BRI port provides the capability for two 64 kilobit per second channels and one 16 kilobit per second channel. The PRI port provides for 23 64 kilobit per second channels and one 16 kilobit per second channel. The two ports are elements of ISDN services which can be used to provide end-users with voice and data communications. The cost study develops incremental port investments using a Bellcore ISDN model and recurring capital costs and operating expenses using ACES.

- *Two-Wire Analog Trunk Port (Direct Inward Dial).* The study determines the recurring and non-recurring costs to provide an end office trunk connection capable of providing direct inward dialing (DID). DID is a central office feature which enables incoming calls to private branch exchanges (PBXs) located on customers premises to be handled without the assistance of an attendant. Calls are routed directly to the PBX which provides answering and supervision of calls. The study determines the incremental investment and recurring monthly costs for equipment necessary to provide this feature. Non-recurring costs for providing switch translations at service activation also are included in the study.

  Recurring and non-recurring costs also are developed for DS1 trunks in the Unbundled Digital DS1 Trunk Port cost study.

- *Feature-Related Non-Recurring Costs*. There are several studies which develop the costs of activating central office features. These include features available on analog line ports (e.g., custom calling and CLASS features), ISDN port features and Centrex-like features. The studies identify activities, such as performing switch translations, necessary to activate features and the time required to perform the activity. Direct labor rates are used to compute non-recurring costs.

The study documentation for each of these network elements provides details on input cost data, calculations and results. In each case, the general approach described in section 2 is followed. Refer to the individual study documentation for additional information.

Transport Costs

5.1 Study Purpose

Transport refers to cable facilities, circuit equipment and other plant providing communications paths among SWBT central offices. Transport facilities are used to provide *dedicated transport* for private line and other special services and *common transport* for local and toll message traffic. Dedicated transport unbundled network element costs are computed in SWBT's Unbundled Dedicated Transport cost study, and common transport costs are computed in the Common Transport cost study. The studies provide recurring costs and non-recurring costs for service activation of transport network elements.

5.2 Dedicated Transport

The Dedicated Transport cost study calculates the cost to provide network elements for dedicated channels of varying bandwidths and lengths among SWBT central offices. The network elements included in the study are:

- *Entrance Facilities*. Cable and circuit equipment for access from a customers premises to the SWBT serving central office. Access is provided via a dedicated channel with bandwidth at the DS1 level (1.544 megabits / second) or the DS3 level (45 megabits / second or equivalent to 28 DS1 channels). Costs are distinguished for rural, suburban and urban geographic areas (zones 1, 2 and 3, respectively).

- *Interoffice Facilities*. Interoffice (IO) facilities are the cable and circuit equipment between SWBT central offices which provide communications paths among the offices. Fiber optic transmission facilities are assumed. Costs are computed for the DS1 and DS3 bandwidths, as well as for a voice grade dedicated interoffice channel (64 kilobits / second). IO facility costs are computed for each zone and between zones (inter-zone IO facility costs).

  Interoffice facilities require circuit equipment at each central office. Between central offices are cable and wire facilities. The amount of cable and wire facilities depends on the route mileage between offices. Recognizing these factors, the study determines interoffice facilities costs for the "first mile" including the central office circuit equipment, and for each additional mile.

- *Cross Connects*. This network element includes equipment connecting interconnecting carrier equipment to SWBT's transport facilities. Cross-connect costs are computed for voice grade connections (two wire and four wire connections), DS1 And DS3.

- *Digital Cross-Connect System*. A network element which terminates digital transmission facilities operating at standard digital signal rates. The system automatically connects tributary transmission signals according to a "map" electronically stored in the system.

Digital cross-connect system costs are computed for voice grade, DS1 and DS3 terminations.

- *Multiplexing*. The capability of combining multiple transmission channels over the same transmission facilities. Costs are provided for DS1 to DS0 multiplexing (i.e., combining 24 voice grade channels to form one 1.544 megabit channel) and DS3 to DS1 multiplexing (28 DS1 for one DS3).

The results of the study for the two primary network elements, entrance facilities and interoffice facilities, are illustrated in Figure 5.1.

Figure 5.1

Unbundled Dedicated Transport Cost Study Results

Entrance Facilities

	Geographic Zone	Monthly Recurring Cost	Non-Recurring Cost First	Non-Recurring Cost Additional
DS1	1	$XX.XX	$XX.XX	$XX.XX
	2	$XX.XX	$XX.XX	$XX.XX
	3	$XX.XX	$XX.XX	$XX.XX
DS3	1	$XX.XX	$XX.XX	$XX.XX
	2	$XX.XX	$XX.XX	$XX.XX
	3	$XX.XX	$XX.XX	$XX.XX

Interoffice Transport

	Geographic Zone	Monthly Recurring Cost First Mile	Monthly Recurring Cost Add'l Mile	Non-Recurring Cost First	Non-Recurring Cost Additional
Voice Grade	1	$XX.XX	$XX.XX	$XX.XX	$XX.XX
	2	$XX.XX	$XX.XX	$XX.XX	$XX.XX
	3	$XX.XX	$XX.XX	$XX.XX	$XX.XX
	Interzone	$XX.XX	$XX.XX	$XX.XX	$XX.XX
DS1	1	$XX.XX	$XX.XX	$XX.XX	$XX.XX
	2	$XX.XX	$XX.XX	$XX.XX	$XX.XX
	3	$XX.XX	$XX.XX	$XX.XX	$XX.XX
	Interzone	$XX.XX	$XX.XX	$XX.XX	$XX.XX
DS3	1	$XX.XX	$XX.XX	$XX.XX	$XX.XX
	2	$XX.XX	$XX.XX	$XX.XX	$XX.XX
	3	$XX.XX	$XX.XX	$XX.XX	$XX.XX
	Interzone	$XX.XX	$XX.XX	$XX.XX	$XX.XX

5.3 Entrance Facilities Costs

Entrance facilities consist of loop plant from a customers premises to the SWBT serving central office and circuit equipment located at the customers premises and the central office. For a DS1 entrance facility in a rural area, approximately half of the plant investment is cable facilities and half is circuit equipment. In urban areas, about 20% of plant is cable and 80% circuit equipment. (In urban areas, loop lengths are shorter, and cable costs are lower.)

The loop portion of entrance facilities costs is computed in the same manner as unbundled loop costs described in Sections 3.2 - 3.8. The LPVST model is used to compute cable investment per entrance facility. The DS1 cable investment reflects a mix of copper and fiber cables and cable types (aerial, underground and buried). For DS1 entrance facilities, fiber feeder cable is assumed for feeder cable over 6,000 feet. DS3 entrance facilities are assumed to be all fiber.

In addition to the distribution and feeder cables, plant investment is included for the feeder distribution interface, premise termination equipment and frame stringer. These are described in Section 3.2.

Circuit equipment makes up a substantial portion of entrance facility plant investment and costs. Forward-looking circuit equipment designs for copper and fiber entrance facilities are developed. These are called Service Area Function (SAF) designs. For example, the SAF design for DS1 entrance facilities with copper feeder cable calls for use of the following equipment:

- Digital test access units.
- Jack panels.
- Office repeaters.
- Office repeater bay.
- Maintenance terminating unit at the customers premises.

Investments amounts for each equipment item are computed per unit of DS1 capacity. The SAF design uses current vendor material prices and loadings for power equipment, sales taxes and other costs of construction.

A similar SAF design is produced for DS1 and DS3 entrance facilities with fiber feeder cable. The circuit equipment investments for copper and fiber facilities are weighted based on the prospective mix of these cable types to compute average circuit equipment investments. These amounts then are used in ACES along with the cable investments to compute monthly entrance facility costs.

5.4 Interoffice Facility Costs

Monthly IO facility costs are computed for voice grade, DS1 and DS3 channels in rural, suburban and urban geographic zones. Monthly costs for the three bandwidths also are computed for dedicated transport between zones and inter-zone. Costs are calculated for the first mile including circuit equipment in the central office and for each additional mile. Mileage is in terms of air miles between central offices.

Monthly costs include capital costs and operating expenses for the plant (aerial, underground and buried cables, circuit equipment and central office equipment) making up the IO facilities. The total plant investment and mix of plant are based on actual network characteristics (central office

locations, interoffice distances and networks) and the forward-looking, least cost design of IO facilities.[10]

SWBT's COSTPROG model is used to develop IO facility investments for each of the bandwidth - zone combinations.[11] The following is a description of the important aspects of the COSTPROG model for calculating IO facility investments.

- *Inventory of Central Office Pairs*. COSTPROG begins with a complete list of all pairs of central offices in the state for each zone (rural, suburban, urban or inter-zone). The first central office in the pair is called the 'A' location and the second, the 'Z' location. The model contains the distance between these points in *air miles*.

- *Inventory of Networks*. The model also contains a complete inventory of *networks* in the state. Networks are groups of central offices or network nodes connected by IO transmission facilities. Facilities may be configured in one of three possible SONET designs - a uni-directional ring, a bi-directional ring or a chain design. These are alternative transmission facility designs selected by network engineers depending upon IO traffic patterns. The network inventory is used by COSTPROG to identify possible paths for a dedicated transport channel between A and Z central offices. COSTPROG determines the cost of each possible path and uses the *least cost path* in developing transport costs.

  The descriptive data for each network includes the *type of design* (e.g., uni-directional ring), the *bandwidth of the network* (OC3, OC12 or OC48),[12] the *number of nodes* or locations where traffic can enter or leave the network, the *number of fibers* and *actual route mileage*. Each of these is a *driver* of the circuit and cable investment required to provide the network.

- *Fixed and Per-Mile Investments*. COSTPROG contains tables of SONET circuit equipment and fiber investments used to estimate the current cost of constructing each of the network designs in the network inventory. Separate construction costs are provided for ring versus chain designs, for network access and interconnection, and for the IO fiber cable. Circuit equipment costs vary by network bandwidth (OC3, OC12, etc.), and fiber costs by the number of fibers per cable (12, 24, ... 144). Circuit investments are independent of network length, and fiber investment varies depending on route mileage.

---

[10] The IO facilities cost study assumes Synchronous Optical Network (SONET) design.

[11] Investments per voice grade channel, DS1 and DS3 from COSTPROG are entered in ACES where capital costs and operating expenses are computed. See Section 3.11 for a description of the Automated Cost Extraction System (ACES).

[12] OC3, OC12 and OC48 are bandwidths or transmission rates for SONET transmission facilities. An OC3 facility has the capacity of three DS3 fiber optic circuits. A DS3 circuit equates to 28 DS1 circuits, and a DS1 equals 24 DS0 or voice grade circuits. Thus, an OC3 facility has the nominal capacity to carry 2,016 voice grade circuits. An OC12 has the capacity of four OC3s and an OC48, the capacity of 16 OC3s. Since IO facility costs for dedicated transport are expressed per voice grade channel, per DS1 and per DS3, the capacity versus investment required for each network is important.

- *Network Investment Calculation*. COSTPROG calculates the current investment required to construct each network based on the cost drivers described above and the fixed and per-mile investments. Then, for each A - Z central office combination, the model selects the least cost path of networks between them. After selecting the least cost path, COSTPROG computes the fixed and per mile investments per unit of capacity. Separate unit investments are calculated for a voice grade dedicated channel, DS1 and DS3. The results, for example, consist of the fixed investment per DS1 channel for each A - Z central office combination, and the fiber investment per DS1. The fiber investment is divided by the A - Z air mileage to compute the DS1 investment per air mile.

- *Unit Investment Weighting*. The unit investments vary among the A - Z central office combinations due to several factors - SONET design type, bandwidth, route mileage and others. Average fixed and per mile investments are computed for each zone by weighting the unit investments by the number of circuits between each pair of offices.

- *Buried and Underground Cable Split and Conduit Loading*. The last step is to split the fiber investment per mile between buried and underground cable types. This is done by applying current percentages of fiber construction costs for these two cable types. Conduit investment also is calculated based on the current ratio of conduit to underground cable construction costs.

The resulting statewide average unit investments for each zone are used in ACES to compute monthly capital costs and operating expenses.

5.5 Common Transport

The Common Transport cost study computes the transport costs for message traffic; i.e., local and toll calling. Costs are expressed *per minute* of calling.

As described for Dedicated Transport, IO facility costs consist of the *fixed costs* of circuit equipment at central offices or termination points of the facilities and *per mile* costs for cable. In the Common Transport cost study, the former are called *termination costs* and the latter are called *facility costs*. Termination costs are expressed per minute of use, and facility costs per minute, per mile. Costs are provided for calling within the three geographic zones and for inter-zone calling. Figure 5.2 illustrates the study results.

Figure 5.2

Common Transport Cost Study Results

Termination Cost / Minute of Use

Geographic Zone	Recurring Cost
1	$0.XXXX
2	$0.XXXX
3	$0.XXXX
Interzone	$0.XXXX

Facility Cost / Minute - Mile

Geographic Zone	Recurring Cost
1	$0.XXXX
2	$0.XXXX
3	$0.XXXX
Interzone	$0.XXXX

Common transport costs are calculated for each zone in the following steps:

- The *monthly fixed cost per DS1* from the Dedicated Transport cost study is divided by 24 voice grade channels per DS1. This provides the *termination cost per voice grade channel*.

- Separately, the *monthly cost per mile for a DS1* from the same study is divided by 24 voice grade channels, yielding the *facility cost per mile* for a voice grade channel.

- Since costs are to be expressed per minute of use, the average minutes of use per month of a voice grade channel must be calculated.

  The capacity of common transport facilities or message trunks between central offices is sized to handle traffic during the busiest hours. There is a maximum of 60 minutes of calling during the busy hour; however, to provide an acceptable grade of service trunk groups are designed to be used less than 100% during the busy hour. The measure of busy hour use is referred to as *trunk group efficiency*. Multiplying 60 minutes times the trunk group efficiency determines the objective minutes of use of trunk groups.

  The objective minutes of use during the busy hour then is divided by the percentage of calling during the busy hour to compute minutes of use per day. This amount is multiplied by the number of busy days per month to determine total minutes of use per month.

- Finally, the monthly termination and facility costs per mile are divided by monthly minutes of use to calculate corresponding costs per minute of use.

The resulting costs represent the average cost per minute of use for local or toll calling at any time or day for each geographic zone.

5.6 Other Transport Network Element Costs

As mentioned in Section 5.2, there are three other network elements in the Dedicated Transport cost study. For each network element, Service Area Function (SAF) designs are developed reflecting current transmission technologies, vendor material prices, construction cost loadings and equipment capacities. Investments are calculated on a per unit of capacity basis and entered in ACES to compute monthly capital costs and operating expenses. Non-recurring costs for service activation are developed for each network element based on activity times of work groups involved and direct labor rates.

- *Cross-Connect Costs*. SAF designs are prepared for equipment necessary to connect interconnecting carrier equipment to SWBT facilities for two-wire, four-wire, DS1 and DS3 connections. The equipment includes plug-in equipment, intermediate distribution frame arrangements for the cross-connection, digital test access units and jack panels.

- *Digital Cross-Connect System*. SAF designs are used to develop digital cross-connect system (DCS) investments at the DS0 or voice grade, DS1 and DS3 bandwidth levels. Investments reflect current DCS hardware and plug-in equipment. In addition to monthly costs per DCS port, non-recurring costs are determined for DCS establishment, database modification and reconfiguration.

- *Multiplexing*. Monthly costs are computed for providing multiplexing from DS1 to DS0 and DS3 to DS1 transmission levels. For DS1 to DS0 multiplexing, the current cost of D4 frames and common equipment are used. For DS3 to DS1 multiplexing, M13 multiplexing and plug-in equipment are used in the SAF design.

5.7 Non-Recurring Transport Costs

Non-recurring costs are computed for transport network elements including the costs for service activation and disconnection. For each network element, the work groups involved and their activities are identified. Then, for each activity, the activity time for the first network element on a service order and each additional network element are determined. The activity time for additional network elements excludes, for example, travel time and administrative tasks which are attributed to the first network element.

Activity times are applied to direct labor rates for each work group to calculate activity costs, and these amounts are adjusted by the probability the activity occurs each time a network element is ordered. Activity costs for all work groups involved in activating or disconnecting a network element are summed to compute the non-recurring cost.

Operator Services Costs

6.1 Study Purpose

There are several cost studies related to the operator services which are to be provided to local service providers. The first of these is a basic study of the cost to provide *a second of operator productive time* regardless of the particular operator service, such as assistance in completing local or intraLATA toll calls, tracing calls, etc. Another study determines the costs of handling directory assistance calls. Other studies compute the costs of new operator services which will be provided by Southwestern Bell, such as the "branding" of operator services provided on behalf of other local service providers and providing call rating services. Each of these studies is described in the following sections.

6.2 Operator Work Second Costs

The study estimates the forward-looking cost of a second of operator productive time. Approximately 70% of the *operator cost per work second* is the direct labor cost of an operator - the operator wage, the costs of non-productive time (breaks and paid absence), premium wage costs, benefits and social security taxes, and the costs of first line supervision. Also included are support asset and other miscellaneous direct operator expenses. Labor costs are obtained from the 1996 labor rate for an operator in the state and divided by the number of seconds of productive time in which the operator is occupied handling calls (over 90% of productive time). The 1996 labor costs are inflated to the average costs expected during the 1997 - 1999 study period.

In addition to direct labor costs, the operator cost per work second includes the costs of the switching, trunking, and multiplexing equipment necessary to connect customer calls to operators. Also included are costs for use of switch control units, interactive voice response systems and the Line Information Database. These equipment-related costs account for about 13% of the operator work second cost. Capital costs and operating expenses are included for each network element.

The remaining 17% of the operator work second cost largely consists of state-specific costs for numerous activities necessary to support operator services. For example, some of the major activities include:

- Updating software tables in the Operator Services - Methods group.
- Investigating trouble reports related to operator services facilities.
- Processing contracts in Exchange Carrier Relations.
- Others.

The annual costs of these activities are divided by the annual, statewide quantity of local & IntraLATA toll operator assisted calls, 0-transfer calls and CAMA calls to compute an average cost per call, and this figure then is divided by the average number of seconds per call to compute the costs per operator work second for these support activities.

6.3 Directory Assistance Costs

This study computes the average cost of a Directory Assistance (DA) call based on the weighted average of four DA call types:

- *Sent paid, coin call.* DA call placed from a coin telephone.
- *Sent paid, Hotel / Motel call.* DA call placed from a telephone in a hotel or motel, and billed to the hotel or motel.
- *Sent paid, non-coin.* DA call placed from a private residence, business or location other than a coin phone or phone located in a hotel or motel. Billing for the DA call, if applicable, is to the calling phone number.
- *Calling card call.* DA calls paid with a calling card.
- *Bill to third number call.* DA call charged to a telephone number other than the calling or called telephone number.

Almost all calls are either *sent paid, non-coin* or *sent paid, coin calls*. The costs of these two call types are very similar.

Approximately 83% of the cost of a sent paid, non-coin or coin call is operator labor cost. The operator labor cost per work second described in Section 6.2 is multiplied times the average seconds per DA call. DA call handling times are about the same for sent paid, non-coin and coin calls, and increase for the other three call types due to the additional time required to obtain customer information and other call handling tasks.

The remaining costs per DA call are equipment-related. They include switching, multiplexing, and other circuit equipment capital costs and operating expenses for network elements necessary to connect customer calls to DA operators. There also is a small cost for the interactive voice response system.

In the case of calling card and billing to third number calls, costs are included for a query of the Line Information Database (LIDB). This adds to the cost of these call types; however, the additional operator time required to handle these calls is the largest contributor to their higher costs.

Finally, the weighting of call types is based on actual 1996 DA call volumes in the state.

6.4 Local and IntraLATA Operator Assistance - Fully Automated

As in the Directory Assistance cost study described in the preceding section, this study computes a weighted average cost per call for operator assistance on a fully automated basis (i.e., a live

operator is not involved in the call). There are five operator assistance call types which may occur for local or intraLATA calling. These include:

- Station sent paid coin.
- Station collect.
- Station bill to third party, non-coin.
- Station bill to third party, coin.
- Station calling card.

With the exception of station sent paid coin calls, costs per call among the call types are approximately the same. Station sent paid coin calls are lower than the other call types since these calls do not require a query of the LIDB database and are handled by the end office switch (therefore, do not require transport or additional switching). Costs for the other call types include capital costs and operating expenses for switching, transport and interactive voice response systems, as well as the cost of a LIDB query.

The preceding costs vary with call volumes; i.e., as demand for automated operator assistance calls increase capacity requirements and costs for switching, transport, voice response systems and LIDB increase. In addition to these costs, the study includes significant additional costs for vendor maintenance of switch control units and interactive voice systems used in automated calls and the state-specific costs for support activities described in Section 6.2. These additional, "volume insensitive" costs represent about 30% of the cost of a fully automated operated assistance call.

6.5 Call Trace Costs

Call tracing allows a telephone customer to trace an unwanted call although the name and telephone number of the calling party is not revealed. A record is maintained by Southwestern Bell of successful traces, and when three calls are traced to the same calling number, the local law enforcement agency is informed. Since call tracing primarily requires the time of operators, costs are computed based on an estimate of the number of minutes required to conduct a call trace and the direct labor rate for an operator. The study provides the average cost per call trace.

6.6 External Rating / Reference Costs for Facility-Based Providers

With external rating / referencing, SWBT operators will be able to quote rates on behalf of Independent telcos and local service providers. This study computes costs for six categories of non-recurring activities which are necessary to establish this new service.

The first two categories consist of activities necessary to initially and subsequently load (what) with (what). Estimates of activity times required of personnel in Operator Services and Customer Services are applied to direct labor rates to compute costs per initial and subsequent load.

The other four categories consist of one-time activities which must be performed regardless of the number of carriers who use this service. It includes activities in Operator Services. Information

Services, Marketing and other work groups necessary to design the service, develop methods and procedures, train personnel, etc. Costs are based on activity times and direct labor rates and are expressed as total cost figures for the state.

6.7 Branding Costs for Facility-Based Providers

Branding for facility-based providers is a new service in which automated telephone equipment will provide recorded announcements to identify a telecommunications company to a caller. Local service providers will be able to provide a distinct recording to identify their company to callers dialing 0+, Directory Assistance and other calls routed to a SWBT operator service system. Similar to the External Rating / Reference service described in Section 6.6, non-recurring costs are developed for initially and subsequently loading local service provider recordings and other information. Costs also are calculated for developing the service and for ongoing maintenance of the service.

6.8 Directory Assistance Call Completion

This study develops the cost per call for the automatic completion of directory assistance calls. The type of call is referred to as a *fully automated sent paid non-coin call*. The cost consists of several components of which the following are the most significant:

- *Hardware costs*. These include the capital costs and operating expenses primarily associated with switching equipment and interactive voice response systems used in handling the automated calls. About 40% of the DA call completion cost is related to hardware costs.

- *Exchange Carrier Relations costs*. Approximately half of the costs of DA call completion are for activities performed in the Exchange Carrier Relations group. These activities include handling contracts for the DA call completion service, preparing rating materials and updating rate-related databases. Costs are estimated based on activity times and direct labor rates, and are expressed per call by dividing total annual costs by the estimated volume of DA calls completed.

Other Network Element Costs

7.1 Overview

The FCC Order requires incumbent local exchange carriers to provide access to a number of unbundled network elements besides local loops, end office switching, transport and operator services.[13] Southwestern Bell has completed cost studies for some of these other network elements, and in this section, a brief description of the studies is provided. For further information, refer to the documentation for each study.

7.2 Tandem Switching

The unbundled tandem switching cost study calculates the cost to Southwestern Bell to provide tandem switching capability throughout its network. The study assumes all forward-looking, digital switching technologies. The Bellcore SCIS model provides tandem switching unit investments which are used in another Bellcore model called the Network Cost Analysis Tool (NCAT). NCAT simulates the handling of various call types through the network and determines the amount of plant investment required to handle calls. This information is used to compute a *tandem switching investment per minute use*. ACES then is used to calculate capital costs and operating expenses associated with the tandem investment. The result of the study is a statewide *tandem switching cost per minute of use*.

7.3 Signaling System 7

Seven cost studies have been completed for elements of Southwestern Bell's Signaling System 7 (SS7) network.

- *SS7 Transport*. This study determines the *cost per octet* for use of signal transport points (STPs) and links in the SS7 network. An octet is the measure of usage in a packet data network such as the SS7 network. An STP is a packet switch that routes signaling messages among the points in the SS7 network. SS7 transport is required by local exchange carriers for call processing and other networking functions.

- *STP Port*. The STP port cost study computes the *recurring monthly cost per port* for a termination on a signal transport point through which signaling messages enter Southwestern Bell's signaling network. The study also includes non-recurring costs for activities necessary to establish the port connection. These include installation, code addition and translation activities.

- *Local Service Provider to SS7 STP Cross-Connect*.

[13] See paragraph 51.319 of the FCC Order (Appendix B, pages B-20 - B24) regarding specific unbundling requirements.

- *Queries*. Costs are determined for several types of SS7 queries on a *cost per query* basis. The first, a Line Information Data Base (LIDB) query, involves a request routed from Southwestern Bell's STP to a service control point (SCP) where a data base is queried to validate a subscriber's credit card number or for third-party and collect calls. A Calling Name query also involves the use of the STP and SCP and is used in providing CallerID service. A third query type is the Toll Free Query needed to identify the "real" telephone number associated with a toll free telephone number. Non-recurring costs also are computed for service order processing to establish the capability for LIDB queries.

- *LIDB / Service Management System (SMS)*. The LIDB / Service Management System is a computer system which provides a number of administrative functions related to the update, maintenance and protection of the LIDB. This cost study develops costs for these various administrative functions.

The Bellcore Common Channel Signaling Cost Information System (CCSCIS) is used extensively in the SS7 cost studies to compute investments per unit of demand (octets, ports and queries). ACES is used to compute recurring capital costs and operating expenses as in other network element cost studies. Non-recurring costs are calculated based on specific activity times and labor rates of personnel performing activities.

7.4 Unbundled Service Order

This study computes the non-recurring costs attributable to processing service orders or Local Service Requests (LSRs) for unbundled network elements. LSR costs are distinguished for simple versus complex orders.

- *Simple*. LSRs which can be processed by a service representative in the Local Service Provider Service Center (LSPSC) *without* the involvement of other work groups. LSRs for loops, analog ports and cross-connects can be processed by a service representative alone.

- *Complex*. LSRs requiring activities by the LSPSC and other work groups, such as Network Sales Support and the Circuit Provisioning Center. Orders for DS1 entrance facilities, dedicated transport and other unbundled network elements with more complex provisioning involve Complex LSRs.

Separate LSR costs are computed for *four order types - new service, change, record and disconnect*. New service and disconnect LSRs apply when service for unbundled network elements is initiated or discontinued, respectively. A change LSR applies when service is modified for existing service, and record LSRs apply when a change in service is requested without a physical change in network elements, such as a change in customer records. Costs differ among the LSR types primarily due to differences in the labor required to complete the orders.

LSR costs consist of the costs of three resources:

- *Labor.* Costs include salaries and wages, benefits and other direct labor-related costs. Labor costs are computed simply by applying direct labor rates to estimates of the activity times required to process LSRs.

- *Data Processing - Central Processing Unit (CPU).* These are costs of computers used to access records and prepare LSRs. Six computer systems are involved in LSR processing, and costs are computed for each based on estimates of the seconds of CPU time required for each LSR and a cost per CPU second of use. CPU costs include hardware costs, costs of employees operating computer systems, software costs and other direct CPU costs.

- *Data Processing - Execute Channel Program (EXCP).* EXCP costs relate to disk and tape storage equipment used in LSR processing. Cost components are similar to those for CPU costs.

Labor, CPU and EXCP costs are computed separately for negotiating and typing the LSR based on the resources consumed in each activity. Labor, CPU and EXCP costs are computed at 1996 cost levels and inflated based on the average inflation rate expected during the next three years - 1997 - 1999.

Since several unbundled network elements may be ordered, LSR costs are developed reflecting a mix the of network elements. For example, in computing the cost of a Simple New Service LSR, the costs of processing orders for an analog port, a loop and a cross-connect are weighted by their expected frequency to compute an average Simple New Service LSR cost. This approach is used for all LSR types.

7.5 Maintenance of Service

SWBT expects local service providers to report suspected failures of its network elements. If there is a network element failure, SWBT will repair the network element as part of its normal charges for the network element. However, if a technician is dispatched to the end user's premises or a SWBT central office and the trouble is not caused by SWBT facilities, the Company will charge for "time and materials." This is referred to as a Maintenance of Service charge.

This cost study computes the costs of the activities necessary to receive trouble reports, dispatch technicians and isolate troubles when Maintenance of Service applies. Costs are calculated for:

- The *first half hour* of work, including administrative activities, technician travel and the first half hour of the technician's time.

- Each *additional half hour* increment of the technician's time.

Since technicians may be called out at different times, costs also are computed for *basic time* during normally scheduled working hours, *overtime* and *premium time*.

As described in Section 7.4, Maintenance of Service costs include the labor costs as well as data processing costs for central processing units and disk and tape storage equipment. Systems used in Maintenance of Service activities include the Loop Maintenance Operations System (LMOS) and the Work and Force Administration / Dispatch Out system. Labor and data processing costs are based on the labor, CPU and data storage resources consumed during the first and each additional half hour of work.

7.6 Operational Support Systems

SWBT has a numerous systems used for service order processing, provisioning, maintenance and repair, and customer billing. Local service providers (LSPs) will be provided access to these systems. The Operational Support Systems (OSS) cost study computes the start-up costs and ongoing costs of providing access to OSS.

- *Start-Up Costs*. These include labor costs for initial programming and training in 1996 and 1997 to establish OSS access. There are almost twenty systems or OSS applications which require programming and training effort to enable access by LSPs. The greatest start-up costs are expected for the following:

  LSP Helpdesk. A seven day / 24 hour call center to support LSPs.

  Directory Assistance. Programming necessary to provide access to Directory One which enables LSPs to provide directory information.

  Verigate. Development of a graphical interface which allows LSPs to query internal information systems containing end user addresses and other information.

  Security. Development of necessary security features to protect integrity of SWBT systems.

  E911. Programming to provide LSP access to PS911 for E911 service.

  Line Validation Administration System (LVAS). Programming necessary to give LSPs access the administration system for the Line Information Database (LIDB).

  Remote Access Facility. Development of network facilities to give LSPs access to OSS through the Data Communications Network.

These programs represent the majority of the start-up costs associated with OSS access. In each case, start-up costs are computed for 1996 and 1997 based on the total hours expected for the program and direct labor costs per hour.

- *Ongoing Operational Costs*. Once OSS access is established, there will be several ongoing operational costs. These include costs for activities related to customer support, managing the EASE Tandem system which will give LSPs access to customer information,